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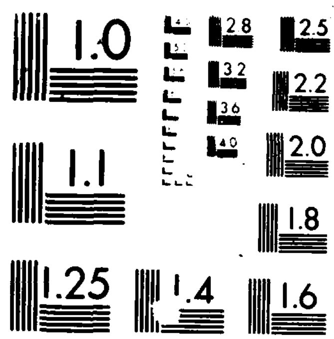

MICROCOPY RESOLUTION TEST CHART

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Results on symmetrizable nonselfadjoint distributed parameter systems are reported on. Operator factorizations are used to characterize the dynamics of a subclass of non-conservative and nonselfadjoint linear distributed parameter systems modeled by partial differential equations subject to various boundary conditions. The results are used to characterize the dynamics of such systems. In addition, the control problem of the validity of using a finite dimensional model in designing a control law for such systems is discussed in terms of stabilization and convergence.

In addition, results on damping ratios and on thermal runaway in strain heating has been determined. Also bounds on decay rates for various finite dimensional versions of structures have been derived.

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Interim Scientific Report
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Qualitative Results for Distributed Parameter Systems

Introduction

Some mechanical components of flexible space platform will be designed with a pre stress (the parameter η in the figure). This pre stress gives rise to nonselfadjointness in the mathematical description (PDE) of the flexible structure. This nonselfadjointness potentially causes difficulty in the design of control laws based on non-distributed actuators. The work performed under this grant to date yields conditions on the control and structural design parameters that allow finite dimensional (i.e., computerized) methods to be good approximations to the fully distributed mass problem. Good approximation as used here refers to convergence and stability retention in control/structure design when vibration and jitter suppression constitute the control objectives.

In particular, certain subclass of nonselfadjoint operators has been shown to be selfadjoint with respect to a particular selfadjoint reference operator. This result is in turn applied to a system of damped nonself-adjoint partial differential equations describing the above mention class of structures. The validity of using a finite dimensional model of the above in control design has been addressed. This result extends previous work of Sakawa and of Gibson yielding inequalities in the system parameters.

The examination of the damping mechanism has resulted in a comparison between experimentally derived damping ratios and damping ratios associated with a finite set of ordinary differential equations describing flexible structures. These results indicate some of the difficulties incountered in trying to compare theory and experiments.

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Results have also been obtained for the decay rates of finite dimensional models of distributed parameter systems. These results were obtained using Gromwell's inequality on the coefficient matrices of the vector differential equations resulting from approximations to the distributed parameter model of a nonconservative selfadjoint structure.

Additional results have been discovered in the area of including more exotic damping terms in the distributed parameter model of the structure. In particuelr, a thermomechanical model for the dynamic response of a one dimensional model of a structure has been considered. It is illustrated that a uniform thin bar subjected to mechanical or thermal disturbance can become unstable and hence requires control.

List of Publications

The following papers have been submitted for publication and authored by the proposer.

1) "Control of Symmetrizable Distributed Parameter Systems," Proceedings of the 24th Conference on Decision and Control, December 1985, pp. 729-731.
2) "Dynamics of Symmetrizable Non Conservative Systems," submitted to the Journal of Applied Mechanics, joint with C. Olsen.
3) "On Damping Ratios for Multiple Degree of Freedom Linear Systems," submitted to the International Journal of Analytical and Experimental Modal Analysis, joint with B.L. Jiang.
4) "Thermal Runaway Due to Strain-Heating Feedback," submitted to the Journal of Applied Mechanics, joint with K.T. Wan and F.A. Cozzarelli.
5) "Response Bounds for Linear Underdamped Systems," to appear in the Journal of Applied Mechanics, joint with K.H. Yae.

Copies of these papers appear in the appendix that follows.

Associated Professional Personnel

Including the Principal Investigator (D.J. Inman) the following were supported on this grant during the reporting period:

- Catherine Olsen, Professor of Mathematics, US Citizen
- K. Yae, graduate research assistant (PhD candidate) US Citizen
- K.T. Wan, graduate research assistant, (PhD candidate)
  US Permanent Resident
- Pauline Cook, graduate research assistant, (MS candidate)
  US Citizen

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